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Mature sustain in mobile application

¹Balavenkatasatyewararao.P ,

¹UG Student, Department of Computer Science and Engineering, SNS College of Technology, Coimbatore-641 035,
Mail Id: balu.satyea@gmail.com

²Aravinth.M.D,

²UG Student, Department of Computer Science and Engineering, SNS College of Technology, Coimbatore-641 035,
Mail Id: aravinthkiruthick29@gmail.com

³Vaishnavi.S ,

³Assistant Professor, Department of Computer Science and Engineering, SNS College of Technology, Coimbatore-641 035, Mail Id: vaishnavi1731@gmail.com

ABSTRACT

Due to increase in life expectancy, the problems that accompanied aging, have become more acute. It is widely acceptable that elder people, except their limited reflexes due to their age, display symptoms of impaired balance, lack of orientation, whereas their health can be burdened by various kinds of diseases. Modern mobile phones provide a medium that incorporates latest generation technologies, are affordable, portable and feature a variety of sensors that are not present even in modern personal computers. We propose a solution, referring to prevention and treatment of incidents that might occur in elder people, and which is based on mobile phones. We designed an application with the ability of automatic fall detection, by using the mobile sensors, warning signal by pressing a button in cases of emergency, detection and warning if the elder moves

away from the place of residence and automatic notification to supervisors as well as visual display to passerbies. Moreover, the application gives the possibility of providing useful instructions towards returning to place of residence through directions given on the map, in case where the elder has lost his orientation. The first three functions provide recording in a database, and also a text message is sent to the supervisor with latitude, longitude and other useful data. Afterwards, you can detect the elder person through google maps. Additionally, an application was implemented for the attending physician, which is connected with the database, through which s/he can obtain a complete picture of the patient 's status, to draw useful conclusions and proceed to possible change in medical treatment.

I. INTRODUCTION

In our century we have all witnessed a dramatic turn, from an era when longevity was a privilege of the few, in one age which is a privilege of the most. Due to increase in life expectancy, the problems that accompanied aging, have become more acute. It is widely acceptable that elder people, except their limited reflexes due to their age, display symptoms of impaired balance, lack of orientation, whereas their health can be burdened by various kinds of diseases. However, technology has advanced rapidly, and in this way we can take advantage of the opportunities that are provided to us. Modern mobile phones provide a medium that incorporates latest generation technologies, are

affordable, portable and feature a variety of sensors that are not present even in modern personal computers. In view of the above, we propose a solution, referring to prevention and treatment of incidents that might occur in elder people, and which is based on mobile phones. We designed an application with the ability of automatic fall detection, by using the mobile sensors, warning signal by pressing a button in cases of emergency, detection and warning if the elder moves away from the place of residence and automatic notification to supervisors as well as visual display to passerbies. Moreover, the application gives the possibility of providing useful instructions towards returning to place of residence through directions given on the map, in case where the elder has lost his orientation. The first three functions provide recording in a database, and also a text message is sent to the supervisor with

latitude, longitude and other useful data. Afterwards, you can detect the elder person through google maps. Additionally, an application was implemented for the attending physician, which is connected with the database, through which s/he can obtain a complete picture of the patients' status, to draw useful conclusions and proceed to possible change in medical treatment.

II. ANDROID MOBILE PHONE

T-Mobile began the distribution in the United States of the HTC G1 mobile phone, the first one incorporating the Google Android FLOSS (Free Libre Open Source Software) operating system. Its user interface is based both on a keyboard and a touch screen that allows to swipe and scroll with the fingers. The Android mobile phone incorporates 2G, 3G, Bluetooth and Wi-Fi radios. Its display can show big graphical and customizable elements designed for visually impaired people. It is possible to show big buttons that are easy to push, or big maps and pictures that enable lost people to locate themselves. Through a simple application, maps and pictures of streets can be incorporated in applications to assist aging people and caregivers. The Android phone incorporates two devices for geolocation. Firstly, the GPS (Global Positioning System) application provide latitude and longitude coordinates. And secondly, the magnetometer/compass can be used to provide direction relative to the earth magnetic poles through an application.

FALL DETECTION

Activities of Daily Living (ADL) are normal activities such as walking and standing. The forces exerted during ADL are usually different than the forces during a fall. By taking the root-sum-of-squares of the accelerometer's three axials, we are able to determine the acceleration. A fall must start with a short free fall period. This causes the acceleration's amplitude to drop significantly below the 1G threshold. This represents the period of time when the actual fall is taking place. The fall must stop and it causes a spike in the graph. The amplitude then crossing an upper threshold suggests a fall. Typically the minimum value for the upper threshold is around 3G. If a person is seriously injured in a fall they usually remain on the ground for a period of time. This is characterized by the 1G flat line at the end of the graph. All of these events occur within a short duration. The following is a graph of a typical fall. If the amplitude crosses the lower and upper thresholds in the set duration period a fall is suspected. However, relying strictly on this method would produce an intolerable number of false positives since certain ADL and the upper threshold can

overlap. We refine the algorithm by taking position into consideration. The assumption is a fall can only start from an upright position and end in a horizontal position. Thus the difference in position before and after the fall is close to 90°. A fall is only suspected if both thresholds are crossed within a duration and the position is changed. Dropping the phone is a frequent motion that resembles a suspected fall. Also a fall may occur but, be minor leaving the user unharmed. To prevent these false alarms we add one more stage to the process, recovery. If a fall is suspected, we start a short timer. This timer allows a fallen user to regain an upright position or a dropped phone to be picked up. If the original position is restored within the time limit the algorithm is reset. If the timer expires and position is not restored, we assume the phone/user is lying on the ground. It then emits a prompt that requires the user to respond within a short time window. A fall is confirmed if the user does not respond. This allows users to reduce the number of false positives. An alert only sends when a fall is confirmed.

APPLICATION FEATURES

The application is designed to be simple to use. To achieve this, we severely limit the number of buttons and options available to the user. The main screen consists of one button and a label. The button starts and stops the fall monitor while the label displays the state. The fall monitor is implemented as a low-powered, Android service. A service allows the fall monitor to constantly run the background. When the monitor suspects a fall, an intent is sent to app. This wakes up the application and attempts to get the user's attention by repeatedly vibrating, flashing LEDs, and playing an audio message. The app prompts the user with a simple pop-up window telling them to press an on-screen button if they are okay. Pressing the button cancels the alert, and the interrupted activity is restored. This gives users the opportunity to limit false positives. The application has additional methods to reduce the number of false positives. We allow the amplitude's upper threshold described in the 'Fall Detection' section to be variable. The application displays a small list of configuration options when the phone's menu key is pressed. One option is to adjust the sensitivity, the capacity to detect a fall. So the less sensitive, the higher the upper threshold is. Given information such as age, weight, height, and level of activity are also factored into the equation. The other option under the application's menu is Add a contact. This allows the user to add social contacts to their emergency contact list. Using social contacts to confirm a fall before alerting an emergency service is another method for filtering false positives. When a fall is confirmed, every contact in the emergency list is sent a SMS message. This message states

that a fall was detected at the given time and includes the GPS coordinates of the fall. It also asks the contact to call the faller. When called, a message is played on the faller's phone and the call is automatically answered and placed on speaker. Enabling bidirectional voice communication between the faller and social contact reduces the number of false positives. The dedicated emergency services are only notified when a social contact also confirms the fall, or in the case if no social contacts call the faller.

ALERT ACTIONS

If the probability suggests the patient is likely wandering, action is taken. First, a notification prompts them to provide feedback if they are okay. It has been shown that interrupts may help bring them out of a demented state. The single option, "Yes, I am Okay," is given. With positive feedback the alert process will pause, this also reduces false positives. If the patient does not respond, it is inferred that he or she is not okay and may be lost. The GPS coordinates are used, with Google Maps and Navigation tools, to give them directions to the safe zone. If no progress is made after a set period of time an alert is sent to the caregivers. Wanderers may not be properly prepared for harsh weather conditions such as extreme hot and cold temperatures and thus faster action must be taken. The device can easily retrieve current weather conditions from reliable, dedicated services via the Internet. This course of action is also taken if the time spent out of the safe zone is too great. The purpose of the alert is to notify the caregiver of wandering behavior, establish bidirectional communication with the patient and relay information. When an alert is issued the device calls a single Google Voice number. Google Voice will then ring several different caregiver numbers simultaneously. When any of those caregivers answer they will be connected and the patient's device will automatically be placed on speakerphone. Enabling bidirectional communication between the patient and caregiver further reduces the number of false positives. Using Google Map APIs, longitude and latitude can be converted into a street address and relayed to the caregiver in several ways including SMS messages, email, or web interface updates. By communicating with the patient and evaluating location information the caregiver can plan an appropriate course of action. In urgent cases, the caregiver can give a command to instruct the patient's device to 3-way a call to 911. By calling 911 from the patient's device, it can be certain that the patient's local 911 station will be called. This process allows caregivers to reduce the number of non-emergency calls to 911 and provide long distance, remote monitoring to the dementia patients.

SYSTEM ARCHITECTURE

In this section we describe the general architecture of our resulting mobile system. The application uses basically two incorporated mobile sensors, namely the Memsensor and the orientation sensor. An algorithm was developed in order to detect the fall using the combination of these two sensors. After concluding that a mobile fall has occurred, a service warns the elder person and a counter starts counting loudly on the screen from 30 to 0. If the counter reaches 0, then an SMS message is sent to the caregiver or relative and an entry is made to the Database. Through SMS (short messaging service), relatives can identify the point of falling and how dangerous it was (by calculation). Furthermore, the application offers a red button that when pressed an SMS alert is sent to the relative's mobile device. At the same time, this event is also kept as a record in the systems Database. Moreover, apart from the basic functions, the application offers a few more complementary services that can be used optionally. The first service detects the patient's position and calculates whether the patient is further away than a set distance. From 50 to 0 meters before exceeding the radius, a sound alert informs the patient. If the patient exceeds the radius then the mobile screen is turned on and the picture of the patient's information appears (something quite useful when the phone hangs from the neck of the patient). If a passerby finds the patient then s/he can call the patient's relative by pressing a corresponding button on the screen. Also, an SMS will be sent to relatives and an entry will be made every 60 seconds in the DB. The second feature, when activated can give directions to the patient what route to follow to return back to home. Apart from the application that is installed in the patient's mobile device, there is an online service where a doctor may have reviewed all corresponding events to his/her patients. Furthermore, this web service can also be used to generate medical hypotheses (change of medication, etc.) and make diagnoses. The overall system's architecture is illustrated in figure 1. We may observe that a patient with a mobile phone receives geographical coordinates from a satellite and connects to the Internet via a base station. In cases when the application is activated (either automatically or by user), a sms is sent (except in the returning home function) to the relative and also an entry in the database through a PHP page located on the Web Server is made. The relative who reads the message can locate the patient. Using a web browser (only if they have an Internet connection) one can identify through a web page that incorporates "googlemaps" services, the patient's exact location. An authenticated doctor can read data from the database through his/her instance of the mobile application in his/her mobile phone. A web page implemented in PHP serves as a link between the application and the database

III. ALGORITHM

Machine learning, a branch of artificial intelligence, is a scientific discipline concerned with the development of algorithms that take as input empirical data, such as that from sensors or databases. The algorithm is designed to (a) identify (i.e., quantify) complex relationships thought to be features of the underlying mechanism that generated the data, and (b) employ these identified patterns to make predictions based on new data. Data can be seen as instances of the possible relations between observed variables; the algorithm acts as a machine learner which studies a portion of the observed data (called examples of the data or training data) to capture characteristics of interest of the data's unknown underlying probability distribution, and employs the knowledge it has learned to make intelligent decisions based on new input data. One fundamental difficulty is that the set of all possible behaviors given all possible inputs is (in most cases of practical interest) too large to be included in the set of observed examples. Hence the learner must generalize from the given examples in order to produce a useful output from new data inputs. Optical character recognition, in which printed characters are recognized automatically based on previous examples, is a classic engineering example of machine learning.

DEFINITION

In 1959, Arthur Samuel defined machine learning as a "Field of study that gives computers the ability to learn without being explicitly programmed". Tom M. Mitchell provided a widely quoted, more formal definition: "A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E".

GENERALIZATION

Generalization in this context is the ability of an algorithm to perform accurately on new, unseen examples after having trained on a learning data set. The core objective of a learner is to generalize from its experience. The training examples come from some generally unknown probability distribution and the learner has to extract from them something more general, something about that distribution, that allows it to produce useful predictions in new cases.

MACHINE LEARNING, KNOWLEDGE DISCOVERY IN DATABASES (KDD) AND DATA MINING

Two terms are commonly confused, as they often employ the same methods and overlap significantly. They can be roughly defined as follows:

- Machine learning focuses on prediction, based on *known* properties learned from the training data.
- Data mining (which is the analysis step of Knowledge Discovery in Databases) focuses on the discovery of (previously) *unknown* properties on the data.

The two areas overlap in many ways: data mining uses many machine learning methods, but often with a slightly different goal in mind. On the other hand, machine learning also employs data mining methods as "unsupervised learning" or as a preprocessing step to improve learner accuracy. Much of the confusion between these two research communities (which do often have separate conferences and separate journals, ECML PKDD being a major exception) comes from the basic assumptions they work with: in machine learning, performance is usually evaluated with respect to the ability to *reproduce known* knowledge, while in KDD the key task is the discovery of previously *unknown* knowledge. Evaluated with respect to known knowledge, an uninformed (unsupervised) method will easily be outperformed by supervised methods, while in a typical KDD task, supervised methods cannot be used due to the unavailability of training data.

HUMAN INTERACTION

Some machine learning systems attempt to eliminate the need for human intuition in data analysis, while others adopt a collaborative approach between human and machine. Human intuition cannot, however, be entirely eliminated, since the system's designer must specify how the data is to be represented and what mechanisms will be used to search for a characterization of the data.

APPROACHES

List of machine learning algorithms

DECISION TREE LEARNING

Decision tree learning uses a decision tree as a predictive model which maps observations about an item to conclusions about the item's target value.

ASSOCIATION RULE LEARNING

Association rule learning is a method for discovering interesting relations between variables in large databases.

ARTIFICIAL NEURAL NETWORKS

An artificial neural network (ANN) learning algorithm, usually called "neural network" (NN), is a learning algorithm that is inspired by the structure and functional aspects of biological neural networks. Computations are structured in terms of an interconnected

group of artificial neurons, processing information using a connectionist approach to computation. Modern neural networks are non-linear statistical data modeling tools. They are usually used to model complex relationships between inputs and outputs, to find patterns in data, or to capture the statistical structure in an unknown joint probability distribution between observed variables.

GENETIC PROGRAMMING

Genetic programming (GP) is an evolutionary algorithm-based methodology inspired by biological evolution to find computer programs that perform a user-defined task. It is a specialization of genetic algorithms (GA) where each individual is a computer program. It is a machine learning technique used to optimize a population of computer programs according to a fitness landscape determined by a program's ability to perform a given computational task.

INDUCTIVE LOGIC PROGRAMMING

Inductive logic programming (ILP) is an approach to rule learning using logic programming as a uniform representation for examples, background knowledge, and hypotheses. Given an encoding of the known background knowledge and a set of examples represented as a logical database of facts, an ILP system will derive a hypothesized logic program which entails all the positive and none of the negative examples.

SUPPORT VECTOR MACHINES

Support vector machines (SVMs) are a set of related supervised learning methods used for classification and regression. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that predicts whether a new example falls into one category or the other.

CLUSTERING

Cluster analysis is the assignment of a set of observations into subsets (called *clusters*) so that observations within the same cluster are similar according to some predesignated criterion or criteria, while observations drawn from different clusters are dissimilar. Different clustering techniques make different assumptions on the structure of the data, often defined by some *similarity metric* and evaluated for example by *internal compactness* (similarity between members of the same cluster) and *separation* between different clusters. Other methods are based on *estimated density* and *graph connectivity*. Clustering is a method of unsupervised learning, and a common technique for statistical data analysis.

BAYESIAN NETWORKS

A Bayesian network, belief network or directed acyclic graphical model is a probabilistic graphical model that represents a set of random variables and their conditional independencies via a directed acyclic graph (DAG). For example, a Bayesian network could represent the probabilistic relationships between diseases and symptoms. Given symptoms, the network can be used to compute the probabilities of the presence of various diseases. Efficient algorithms exist that perform inference and learning.

IV. RESULTS AND CONCLUSION

In this paper i have presented an intelligent mobile multimedia application that can be incorporated into modern mobile smartphones in order to be used for the needs of the elderly. It is in our future plans to evaluate this system in order to test its efficiency in actually helping these people sufficiently.

It is also in our future plans to extend the system's capabilities by incorporating new services. These services include the following:

- Embed a belt measuring heart rate as an external sensor
- Integrate a gyroscope sensor instead of an orientation sensor, for more accurate results
- Integration of social networks to alert senders
- Integrate public agency to alert senders
- Add a system administrator feature.

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